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(11)

EP 0 898 223 A2

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

24.02.1999 Bulletin 1999/08

(51) Int Cl. 6 G06F 3/147

(21) Application number: 98306391.8

(22) Date of filing: 11.08.1998

(84) Designated Contracting States:

AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE

Designated Extension States:

AL LT LV MK RO SI

(30) Priority: 20.08.1997 US 915816

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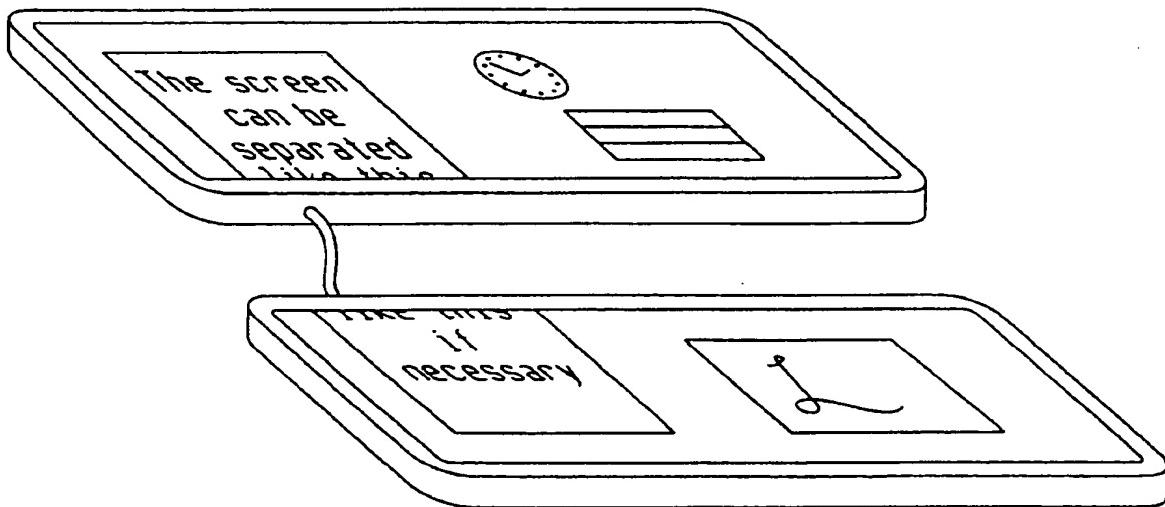
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### (54) Multi-display electronic devices having open and closed configurations

(57) A portable or other electronic device has two or more display devices or screens that can be used to display different subsets of image signals. The effect is that the device simulates the display capabilities of devices having much larger screens. The device has an open or active configuration, in which the multiple screens are available for displaying image signals, and a closed or

inactive configuration, in which some or all of the multiple screens are folded together or otherwise stowed away to reduce the size of the device for storage and/or carrying. By simulating large-display operations, electronic devices according to the present invention are capable of presenting more useable information to the user than is otherwise possible using prior art devices having a single small screen.

FIG. 5



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display displaying the full image. The multiple small displays combine to simulate the operations of a single large display. As such, device 100 is able to present concurrently more useable information to the user than would otherwise be available to a user of a conventional PDA that had a single small display.

[0010] Displays 104 and 106 may be any suitable type of display device, including liquid crystal displays (LCDs). In device 100, a hinge or other similar mechanism may be used to keep the displays together when used in the open, e.g., active, configuration or the closed, e.g., inactive, configuration. A locking mechanism can be used to keep the combined structure rigid when the screens are unfolded. As shown in Fig. 1(b), the different displays need not be co-planar in order for the device to be used in the active configuration.

[0011] Device 100 has two flat-panel displays 104 and 106 which may be less than 5mm thick without a back-light. When the device is in its inactive configuration, the two sides are folded together. For example, if a 5"x5" display area is implemented using two 5"x2.5" displays, the two displays are stored flat against each other. The inactive area is therefore only half of the active area, resulting in a more compact configuration for carrying and/or storing the device.

[0012] Fig. 1(c) shows a perspective view of a portable electronic device in the open configuration, according to an alternative embodiment of the present invention. According to this embodiment, display 102 of Fig. 1(a) and display 104' of Fig. 1(c) are positioned back-to-back within the top half of the device. In one implementation of this embodiment, the device has backlighting means located behind display 106', and displays 106' and 104' are transparent. For such an implementation, the backlighting means behind display 106' will illuminate display 102 when the device is in the closed configuration as shown in Fig. 1(a). In this way, a thinner device with backlighting can be achieved. Furthermore, in certain embodiments, display 102 of Fig. 1(a) and display 104' of Fig. 1(c) may be implemented as a single display device that is adapted to generate images for both the open and closed configurations and possibly at the same time.

[0013] Fig. 2 shows a block diagram of an electronic device 200, according to one implementation of the present invention. For example, electronic device 200 may be modified as needed to implement device 100 of Figs. 1(a)-(b). Device 200 has two or more display devices that may be used to display different sets of image signals to create the effect of a larger display.

[0014] In particular, image generator 206 generates image signals for display on display devices 210. The image signals may comprise any conventional type of image signals, including text, video, graphics, or any combination thereof. Display driver 208 receives the image signals from image generator 206 and distributes appropriate subsets of image signals to the various display devices 210 for display. Each display device 210

operates as a distinct image display device. The effect however of all of the display devices 210 operating together under the control of display driver 208 is the simulation of a larger display device displaying all of the image signals generated by image generator 206. Image generator 206 and display driver 208 may be implemented on a single processor, either in hardware, in software, or in a combination of both hardware and software.

5 [0015] Electronic device 200 also has optional local input device 202 and optional remote input device 204. Local input device 202 may be any suitable device that enables a user to enter information into device 200, such as a keyboard, a keypad, a stylus for a touch screen, a thumb wheel for scrolling, or a track pad. This information is received by image generator 206 for appropriate updating of the image signals to be displayed. Remote input device 204 may be an antenna, network, or cable port, or other suitable type of interface for receiving information from a remote source. This information is also received by image generator 206 for the update of the images to be displayed. In particular implementations, one or more of the display devices may be touch sensitive to operate as additional input devices of device 200

20 for the input of user-selected information to be fed back to image generator 206.

[0016] Fig. 3 shows a block diagram of an electronic device 300, according to an alternative implementation of the present invention. Electronic device 300 is analogous to electronic device 200 of Fig. 2, except that each display device 210 in device 300 has its own display driver 308 to control the display of subsets of image signals. Image generator 306 and display drivers 308 may be implemented on a single processor, either in hardware, in software, or in a combination of both hardware and software.

[0017] Depending on the implementation, the function of dividing image signals into subsets for display on the various display devices may be performed by either the image generator or the one or more display drivers. Even in device 300 of Fig. 3, where each display driver 308 interfaces with only a single display device, image generator 306 could generate and store the image signals into memory, and each display driver 308 could know which subset of those image signals to retrieve from memory. In any case, the image signals are divided into subsets based on the portions of each image displayed by the various display devices. For example, in the embodiment of Fig. 4, where the display devices display the top and bottom halves of each image, respectively, the image signals are divided into two subsets accordingly. Similarly, in the embodiment of Fig. 6, where the display devices display the top half, lower left quarter, and lower right quarter of each image, respectively, the image signals are divided into three subsets accordingly.

[0018] Figs. 4-6 shows portable electronic devices, according to possible embodiments of the present in-

apparatus of claim 3, wherein at least one display device can be used to display images in the closed configuration.

8. The device of claim 1 or the method of claim 2, or apparatus of claim 3, comprising one display driver for each or some or all of the display devices. 5
9. The device of claim 1 or the method of claim 2, or apparatus of claim 3, wherein the image generator and the one or more display drivers are implemented on a single processor. 10
10. The device of claim 1 or the method of claim 2, or apparatus of claim 3, wherein the one or more display drivers are implemented in software, or hardware. 15
11. An electronic device comprising first and second displays oppositely oriented, such that: 20

when the device is in a closed configuration, the first display is visible to a user and the second display is hidden from view; and  
when the device is in an open configuration, the second display is visible to the user. 25
12. The device of claim 11, further comprising a third display, such that, when the device is in the open configuration, the second and third displays display different subsets of image signals. 30
13. The device of claim 11, wherein the first and second displays are mounted back-to-back and further comprising backlighting means located behind the third display, such that, when the device is in the closed configuration, the backlighting means is adapted to illuminate the first display. 35
14. The device of claim 11, wherein: 40

when the device is in the open configuration, the device is adapted to operate as a personal digital assistant; and  
when the device is in the closed configuration, the device is adapted to operate as a portable telephone. 45
15. The device of claim 11, wherein the first and second displays are implemented as a single display device adapted to generate images for both the open and closed configurations. 50

FIG. 1C

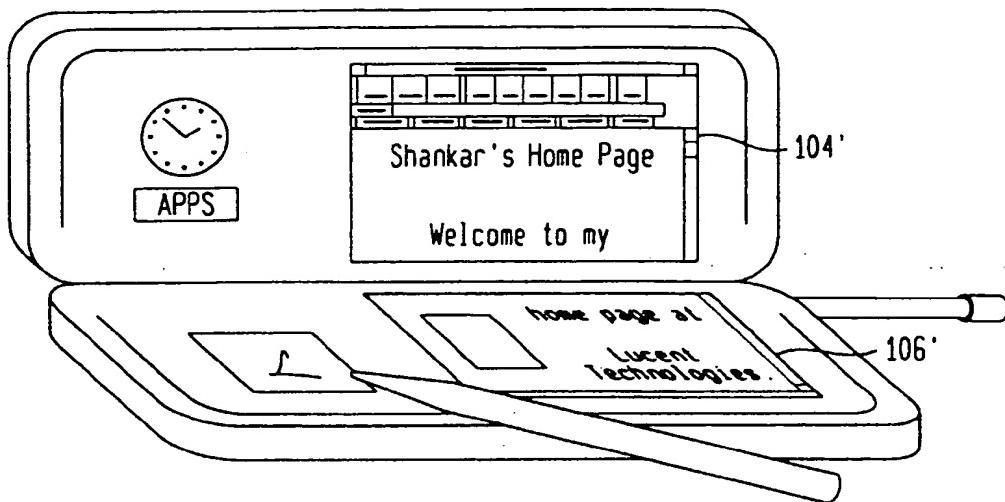


FIG. 2

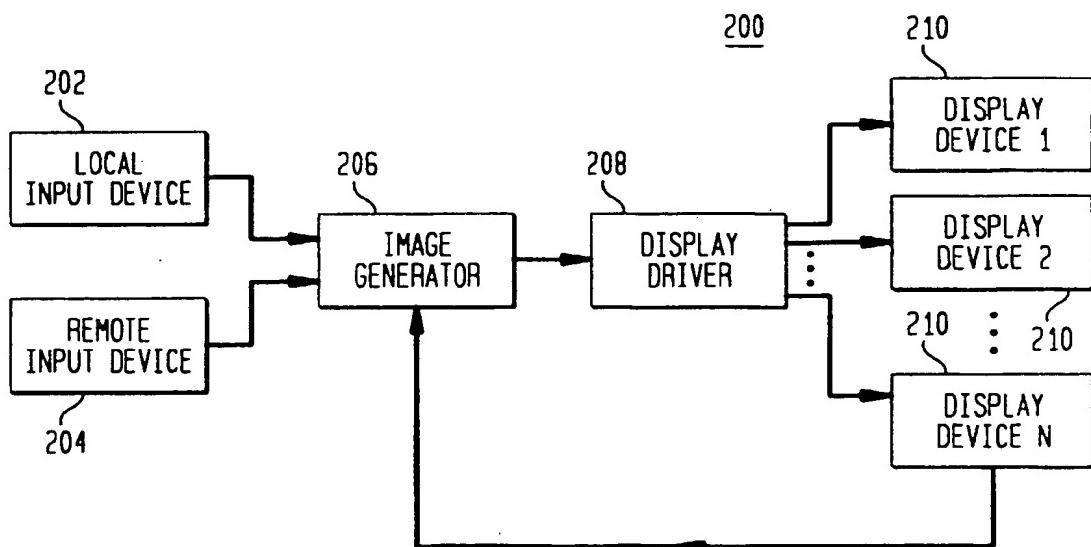


FIG. 5

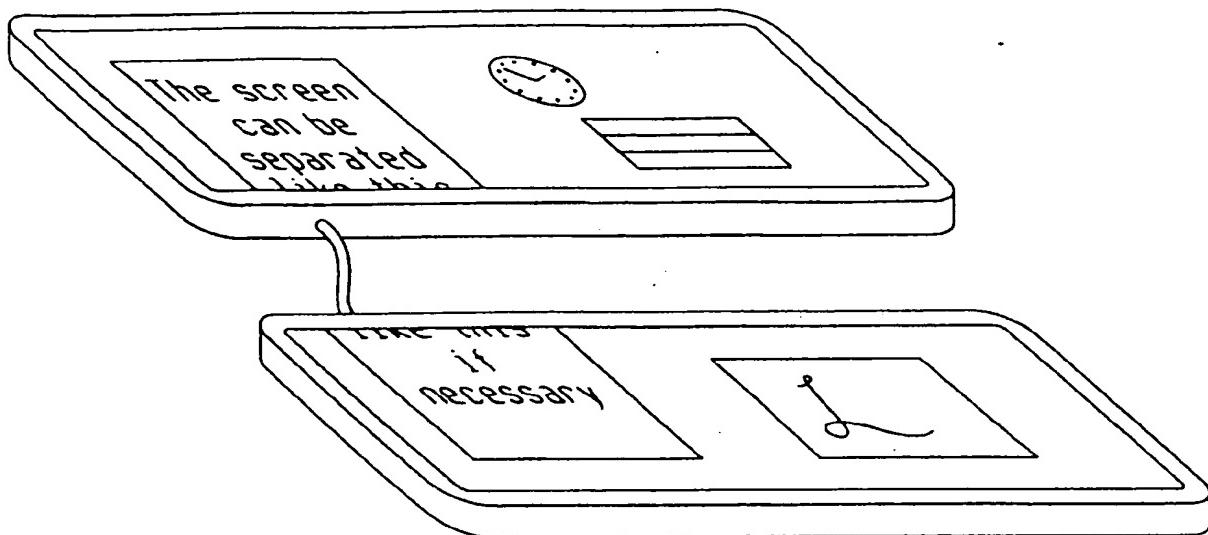
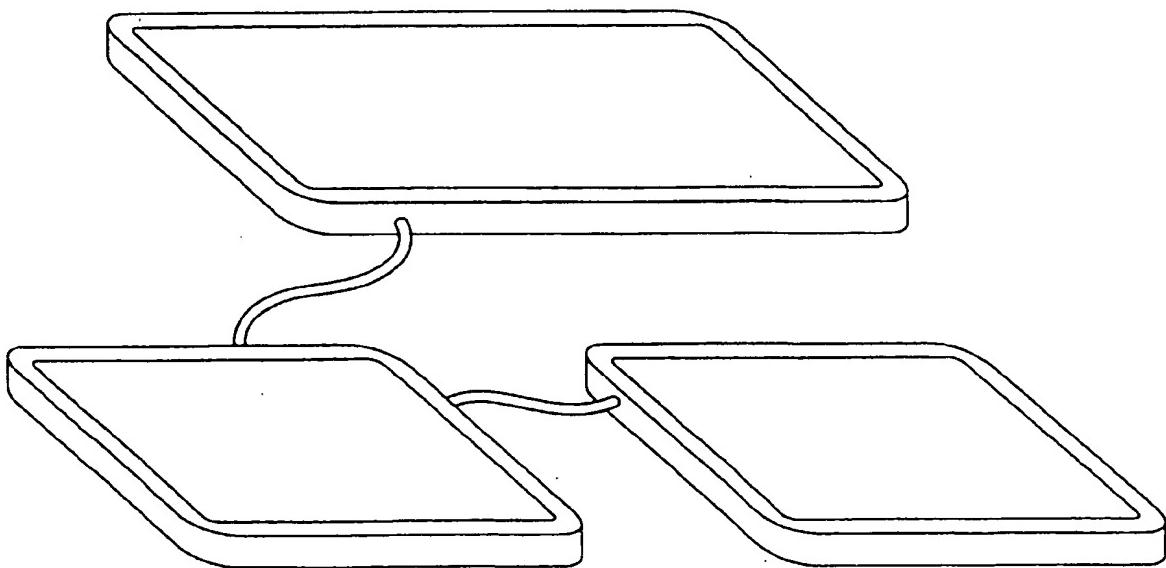


FIG. 6



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(11)



EP 0 898 223 A3

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
17.03.1999 Bulletin 1999/11

(51) Int Cl. 6: G06F 3/147

(43) Date of publication A2:  
24.02.1999 Bulletin 1999/08

(21) Application number: 98306391.8

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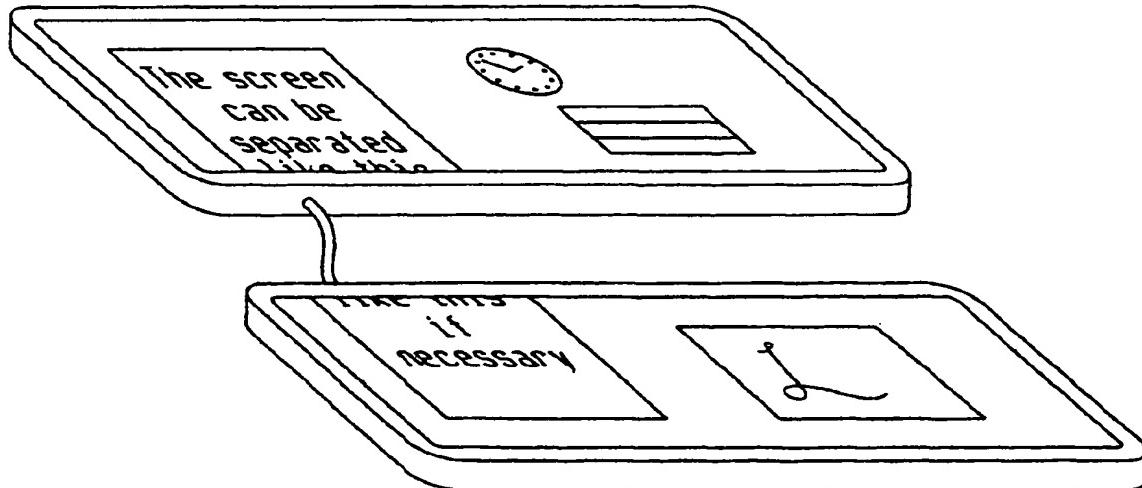
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FIG. 5



ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 98 30 6391

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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19-01-1999

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